THE VALUE OF COMMISSIONING IN PROVIDING HIGHLY EFFECTIVE LABORATORY VENTILATION SYSTEMS

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Primary Objective

Ensure safe operation at minimum possible operating costs while maintaining the capacity and flexibility to meet user demands.

Highly Effective System

- Safe - Meets operating specifications and performance criteria.
- Efficient - Minimum Energy Use and Lowest possible operating costs
- Dependable - Available to meet user demands
- Flexible - Adaptable to changing research needs

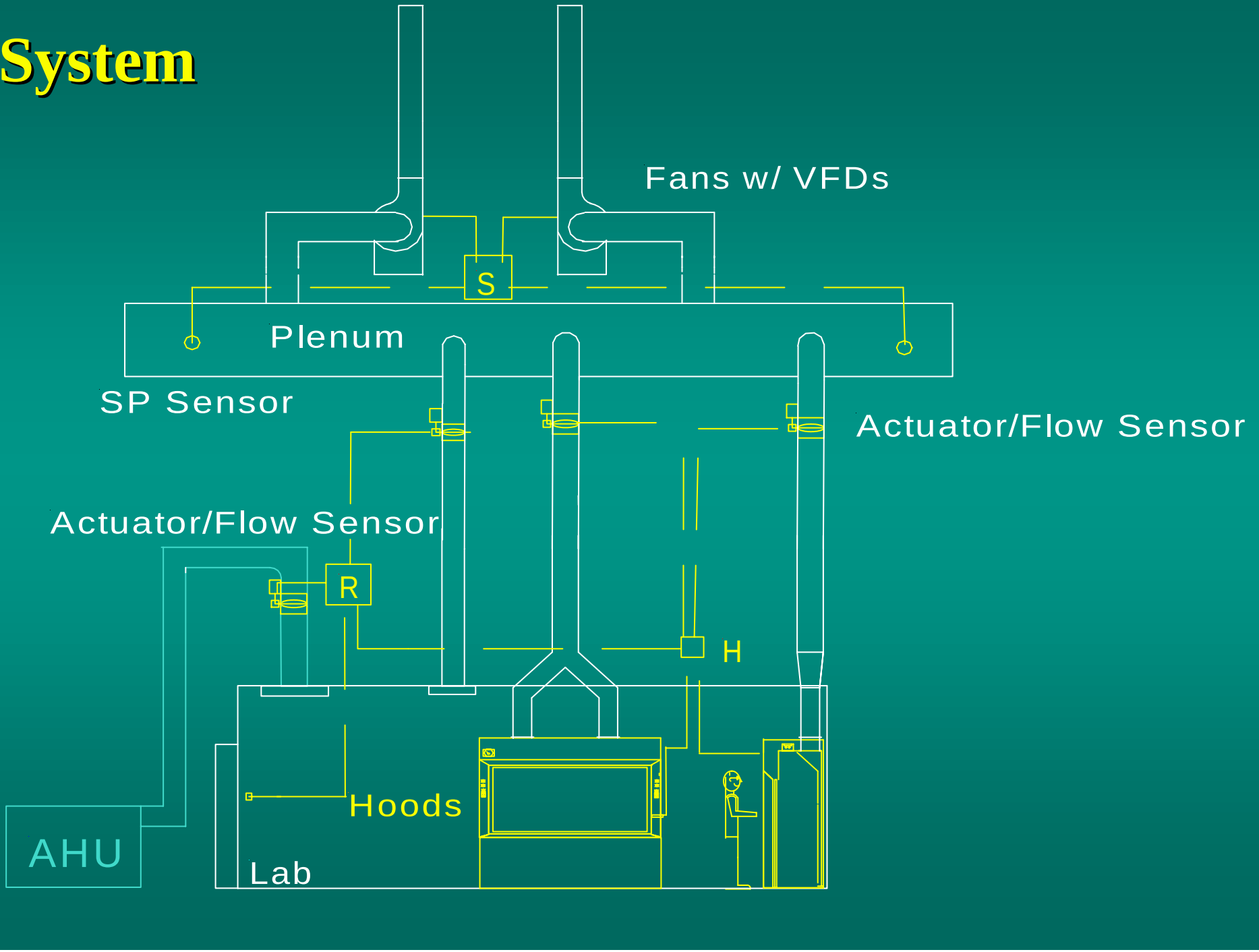
Benefits of Commissioning

- Verification of Design Assumptions
- Identification and Elimination of Problems (Pre-occupancy)
- Benchmark Operation
- Baseline Data for Maintenance
- Compilation of System Documentation

Commissioning Tasks

- Installation and Component Inspections
- Air Balance and Controls Calibration
- Hood Performance Tests
- System Operating Mode Tests
- Diagnostics and Problem Resolution
- Document Final Operating Parameters
- Develop Operations Manual

VAV System


Fans w/ VFDs
S
Plenum
SP Sensor
Actuator/Flow Sensor
Actuator/Flow Sensor
R
H
Hoods
AHU
Lab

Operating Modes

Two Position Hood & Lab Control

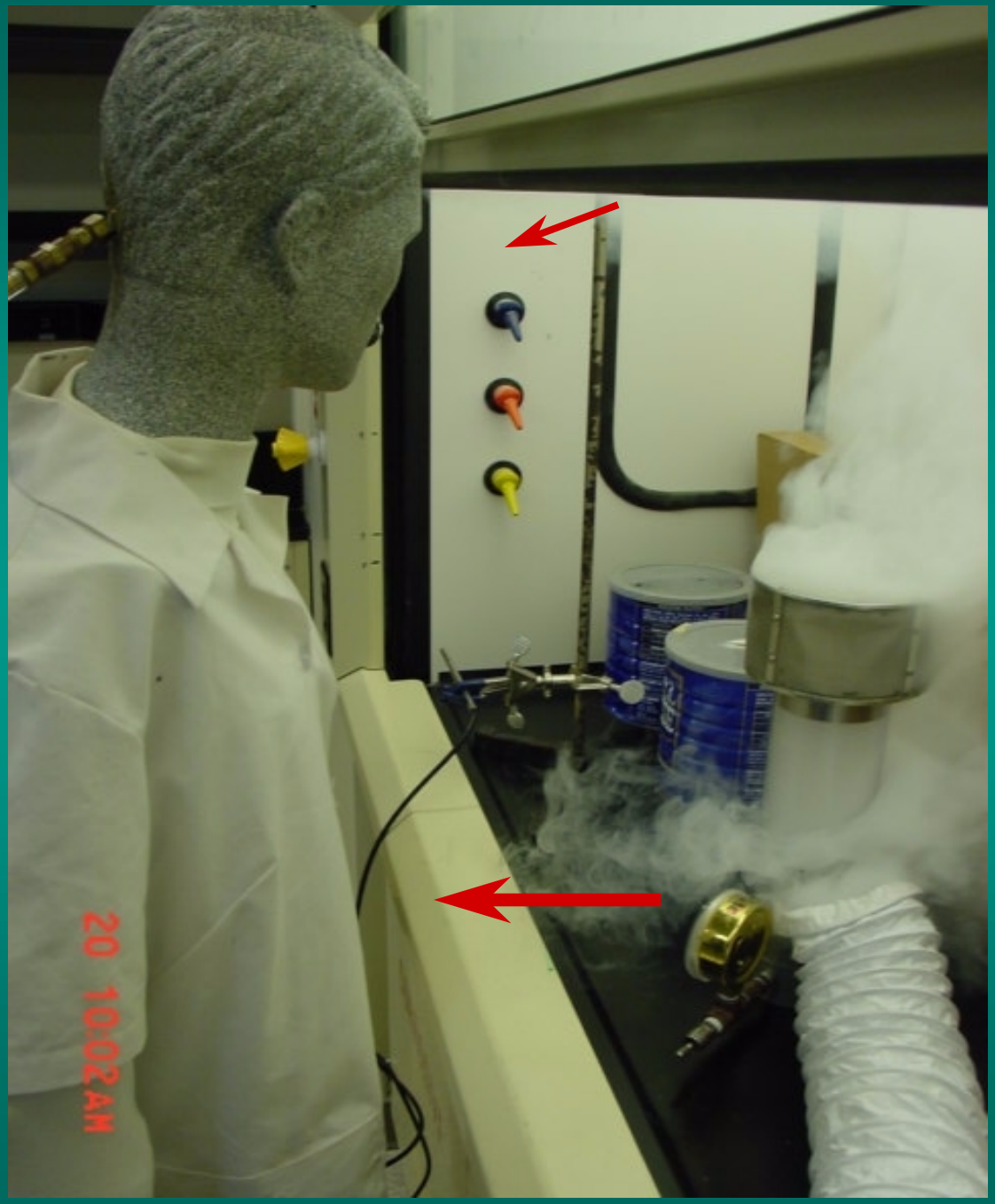
- **Occupied Mode (90% sash - 100 fpm)**
  - **Lights On or**
  - **Sash Open**
- **Unoccupied Mode (60 fpm equivalent)**
  - **Lights Out and**
  - **Sash Closed**

Factors Affecting Performance of Laboratory Fume Hoods

- Hood Installation - Airfoil sill
- Exhaust Magnitude and Stability
- Room Air Supply (Cross Drafts)
- Room Temperature Control
- Operating Mode (Occupied / Unoccupied)

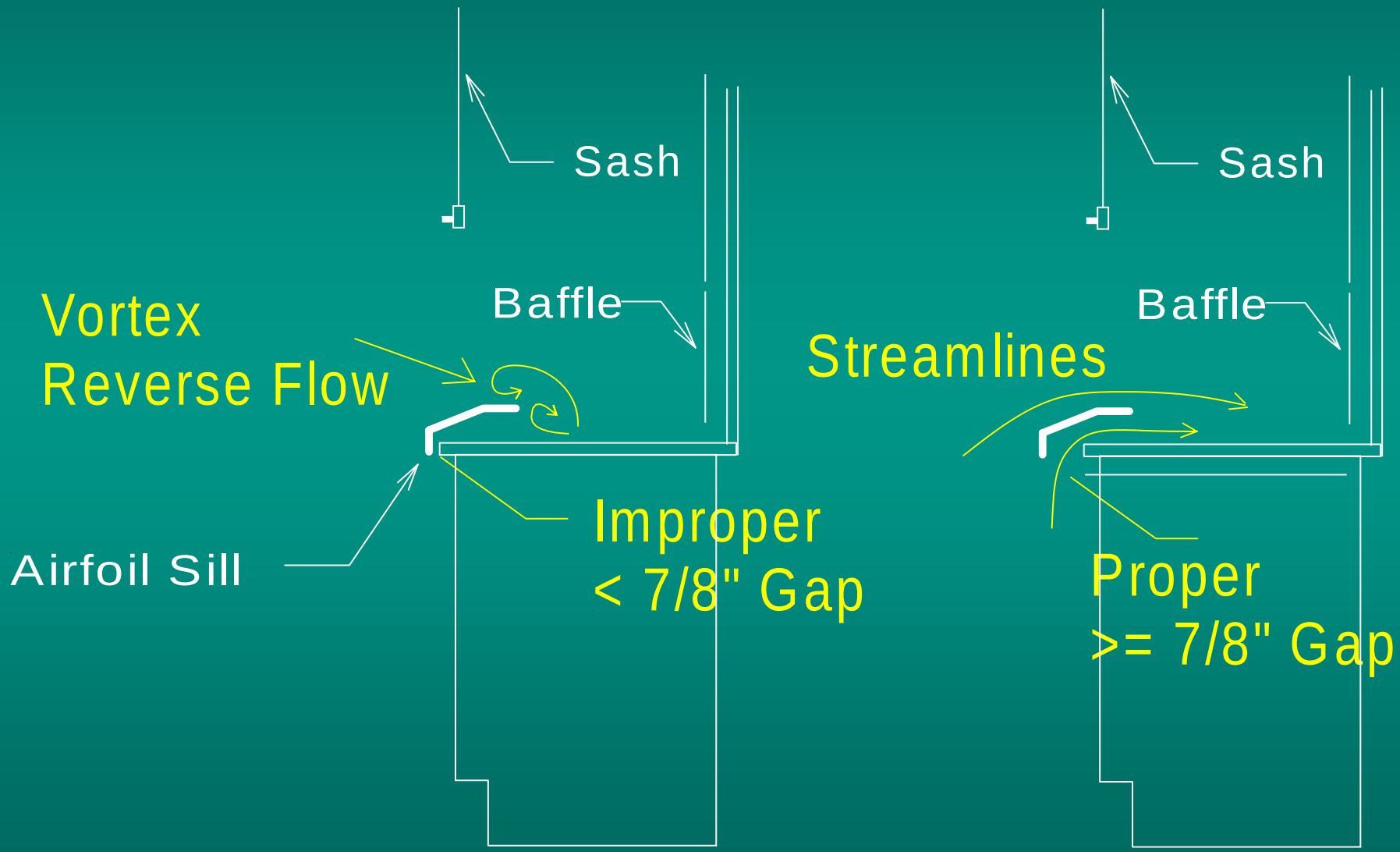
Reverse Flow and Escape

- Airfoil
- Baffle and Slots
- Loading - Obstructions
- Flow Fluctuations
- Cross Drafts




Airfoil
Cabinet
FLAMMABLE
KEEP FIRE AWAY
ACID STORAGE
4 11:52 AM

Airfoil Installation

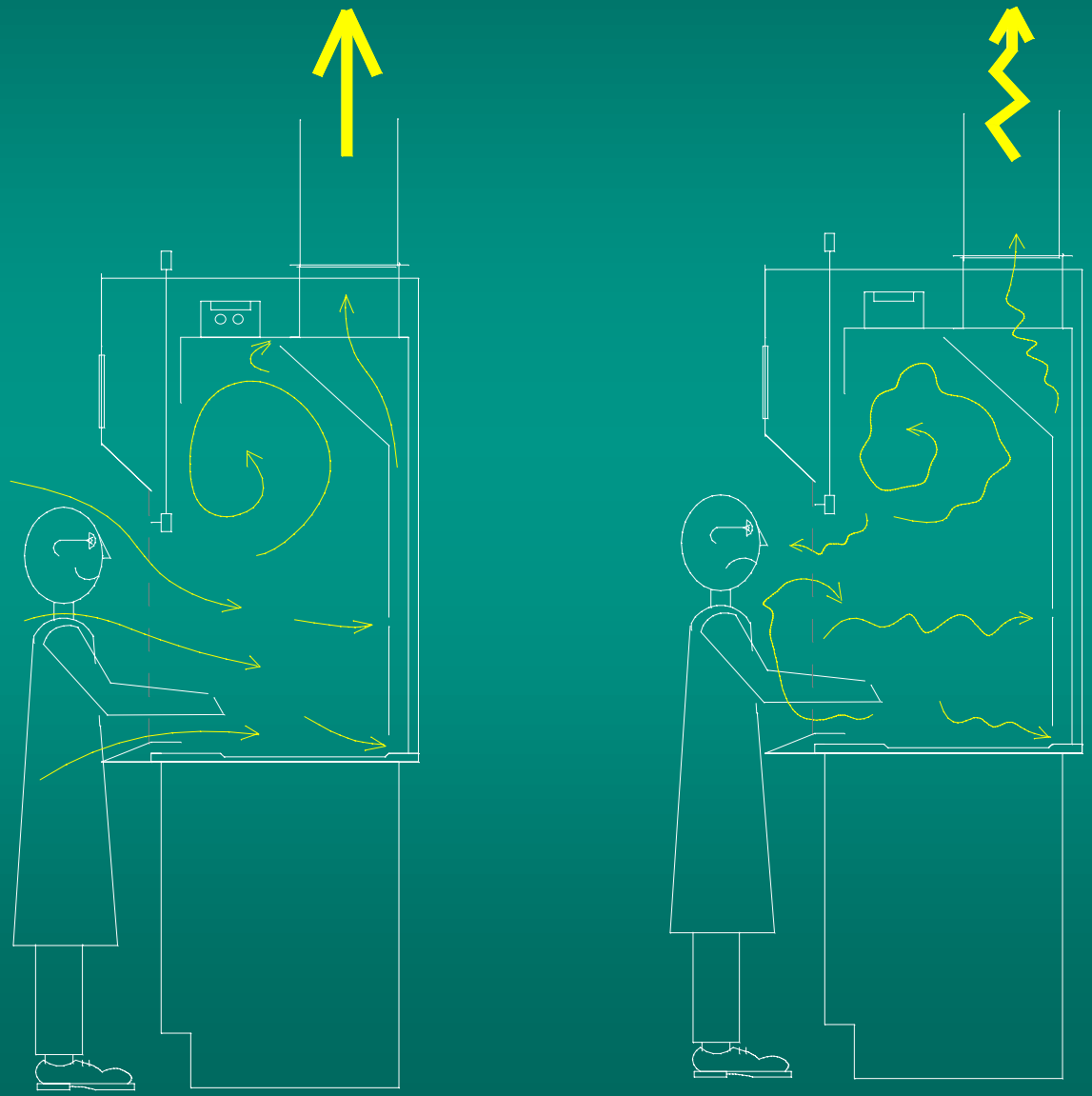


Flow Control and Stability

Unstable exhaust flow causes escape

- Variations between supply and exhaust affect area pressurization
- Variations affect accuracy of sensor calibration and value of BAS Information

Stable vs. Unstable Exhaust Flow

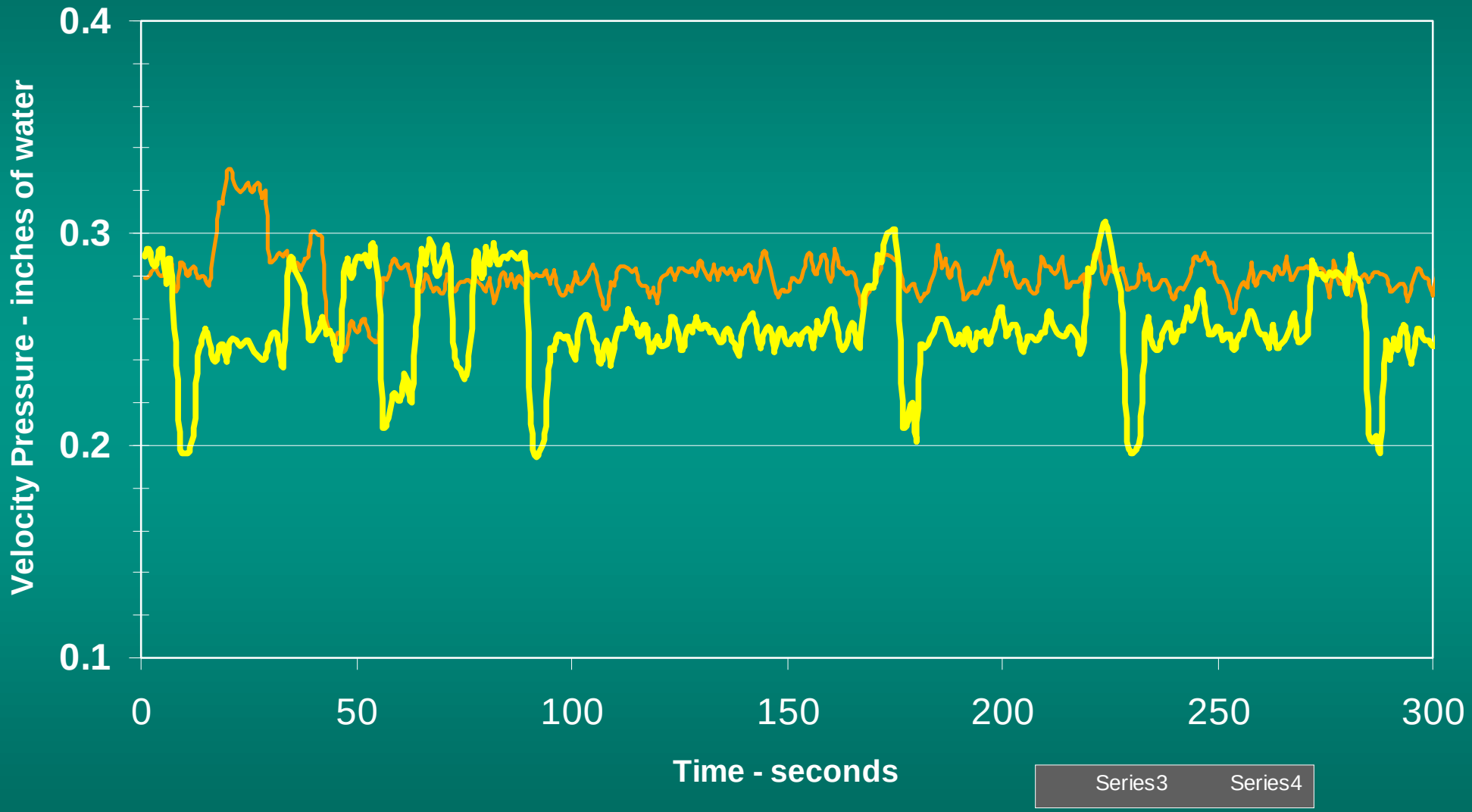


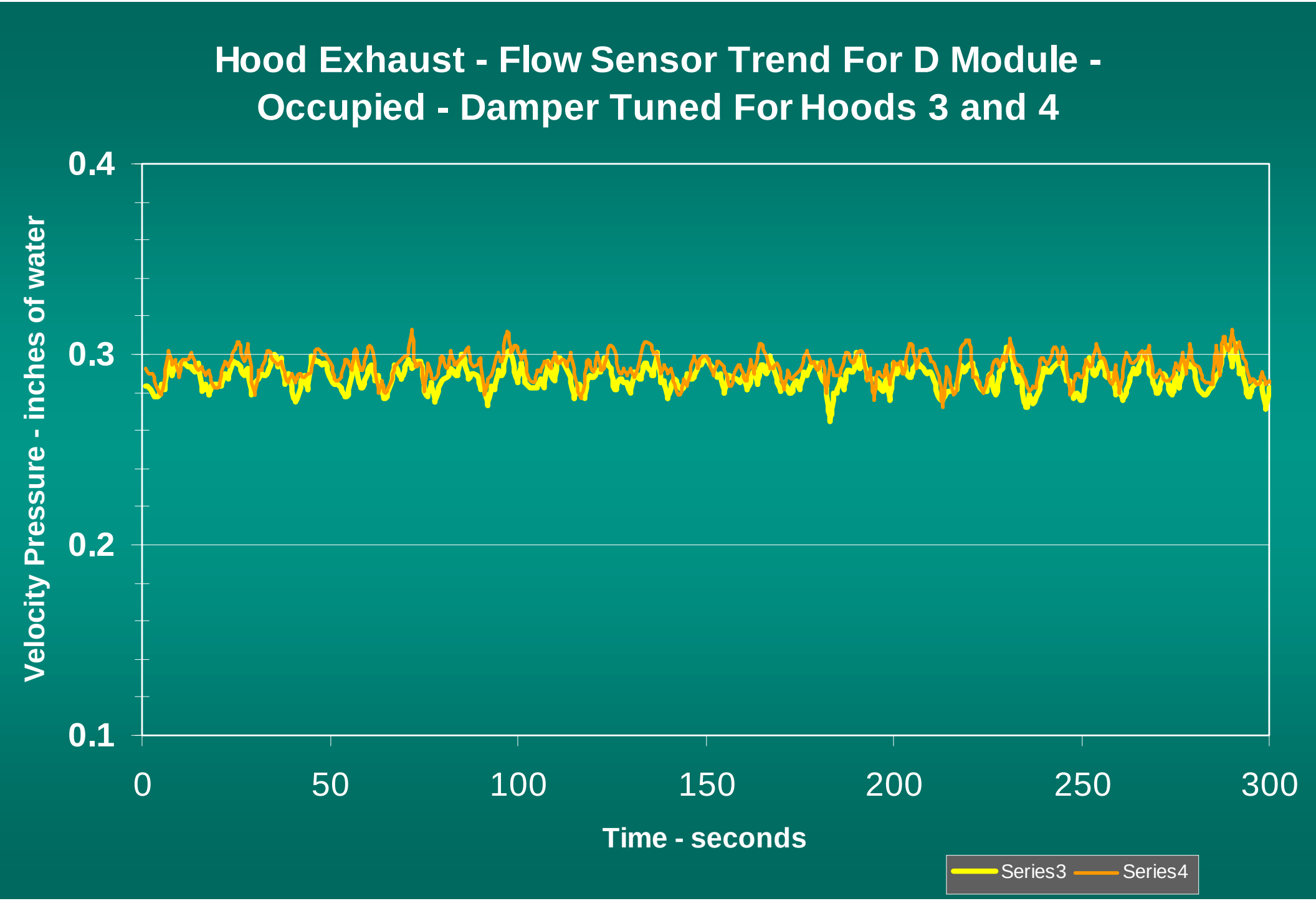
Flow Sensor and Control Damper Location

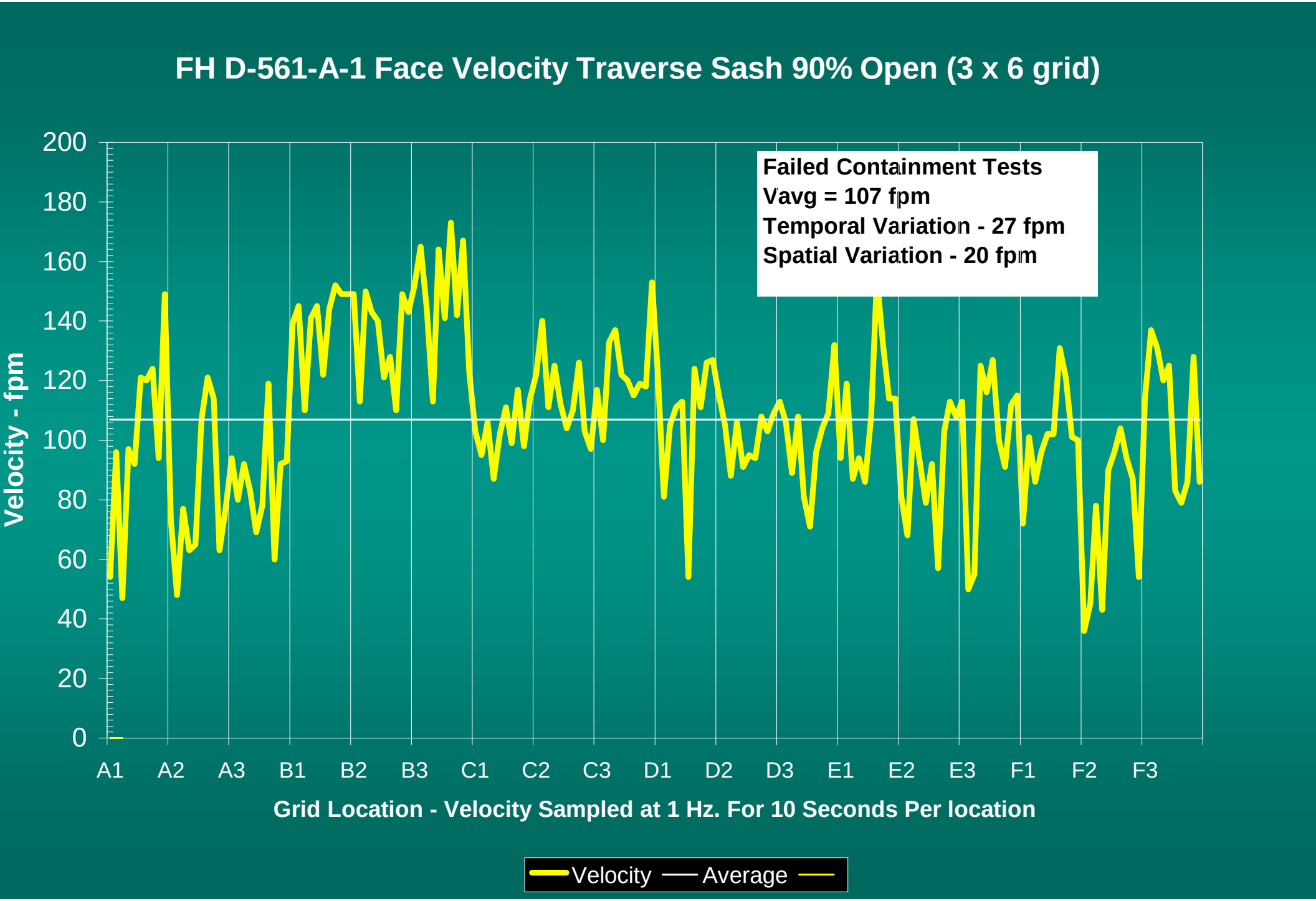
Good

Bad

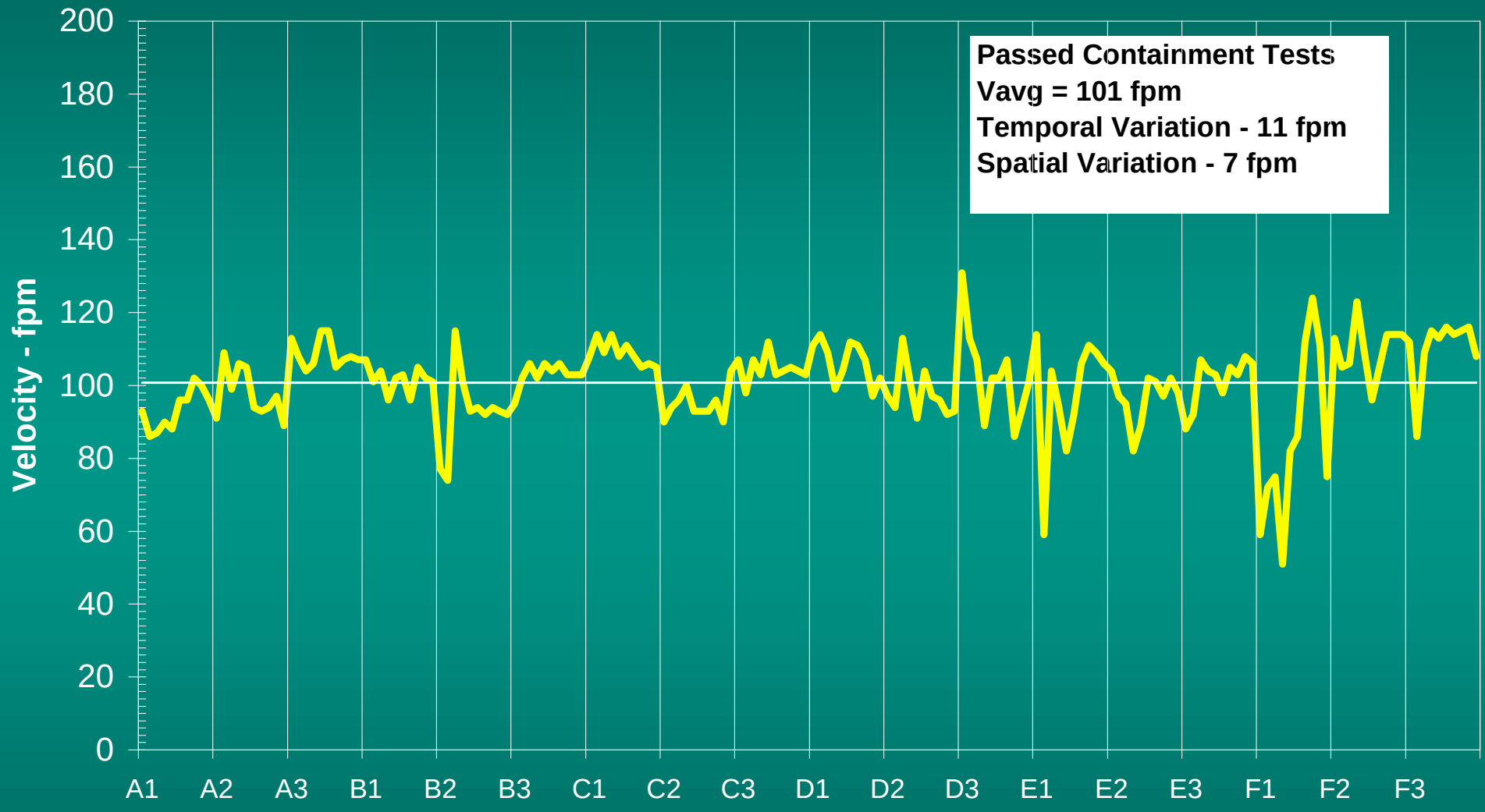
Hood Exhaust - Flow Sensor Trend For D Module - Occupied - Damper Controlled by BAS - Hoods 3 and 4




Hood Exhaust - Flow Sensor Trend For D Module - Occupied - Damper Tuned For Hoods 3 and 4
Velocity Pressure - inches of water
0.4
0.3
0.2
0.1
0
50
100
150
200
250
300
Time - seconds
Series3
Series4


FH D-561-A-1 Face Velocity Traverse Sash 90% Open (3 x 6 grid)
Failed Containment Tests
Vavg = 107 fpm
Temporal Variation - 27 fpm
Spatial Variation - 20 fpm
Velocity - fpm
200
180
160
140
120
100
80
60
40
20
0
A1
A2
A3
B1
B2
B3
C1
C2
C3
D1
D2
D3
E1
E2
E3
F1
F2
F3
Grid Location - Velocity Sampled at 1 Hz. For 10 Seconds Per location
Velocity
Average

FH E-565-A-1 Face Velocity Traverse Sash 90% Open (3 x 6 grid)



Cross Drafts - Room Air Patterns

?

Complementary or Detrimental to Hood Performance

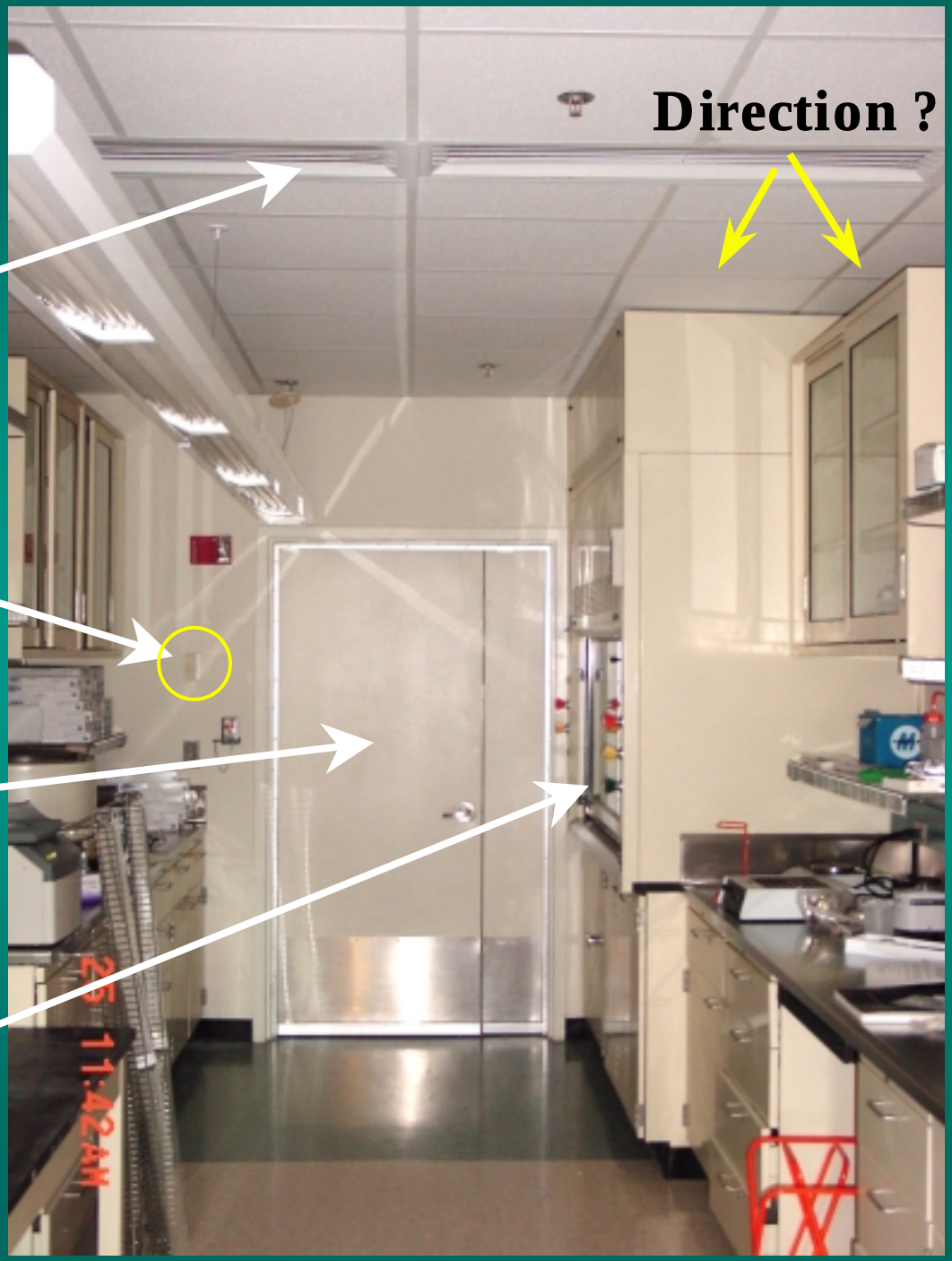
- Type of Diffuser
- Location and Orientation
- Volume and Terminal Velocity

Linear Slot Diffusers

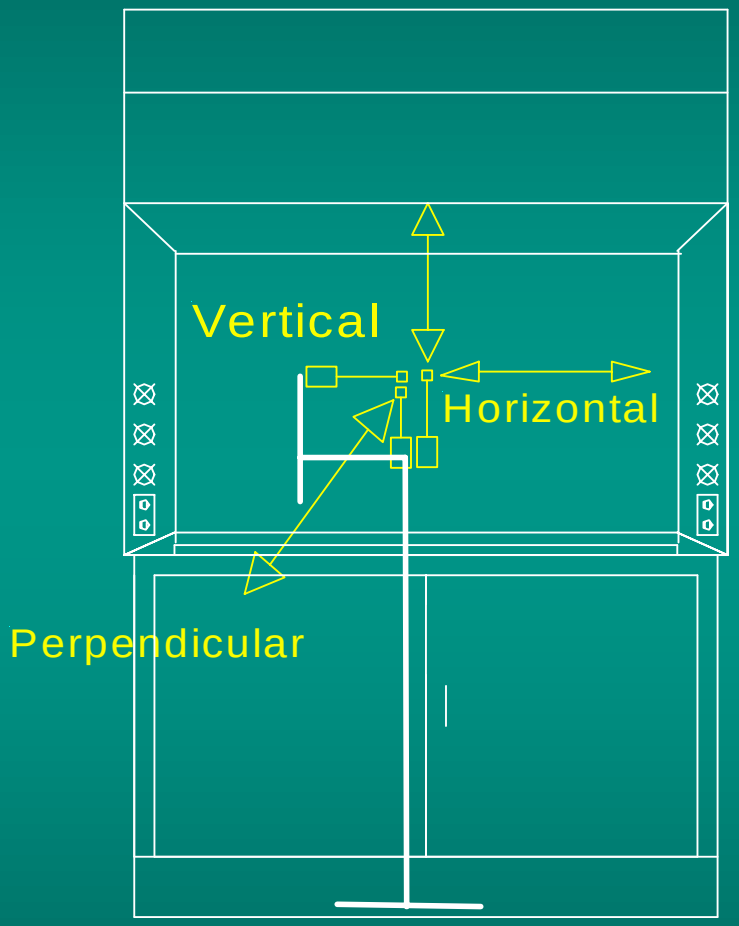
Thermostat

Interlocking
Service Door

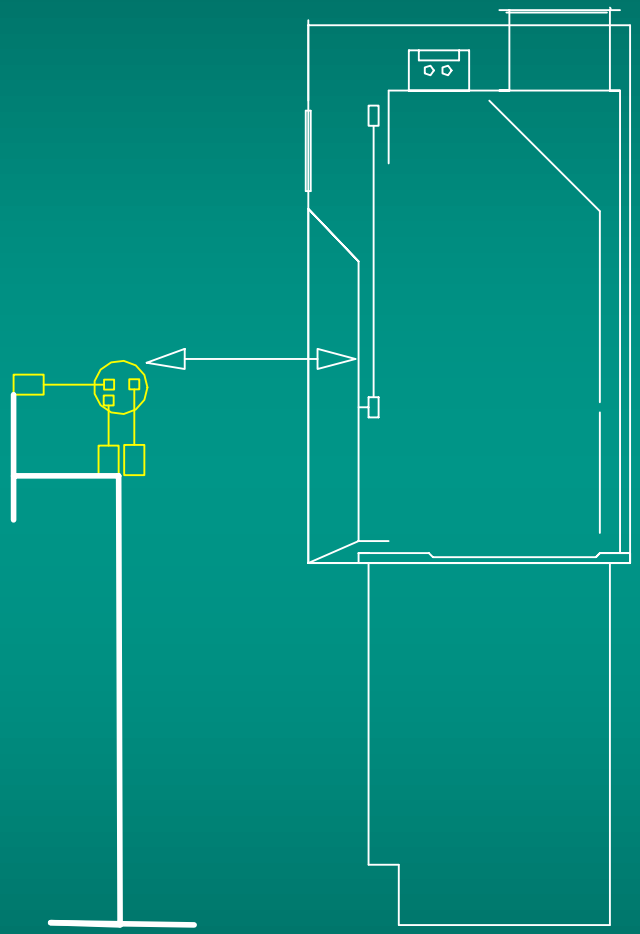
Hood



Cross Draft Tests €



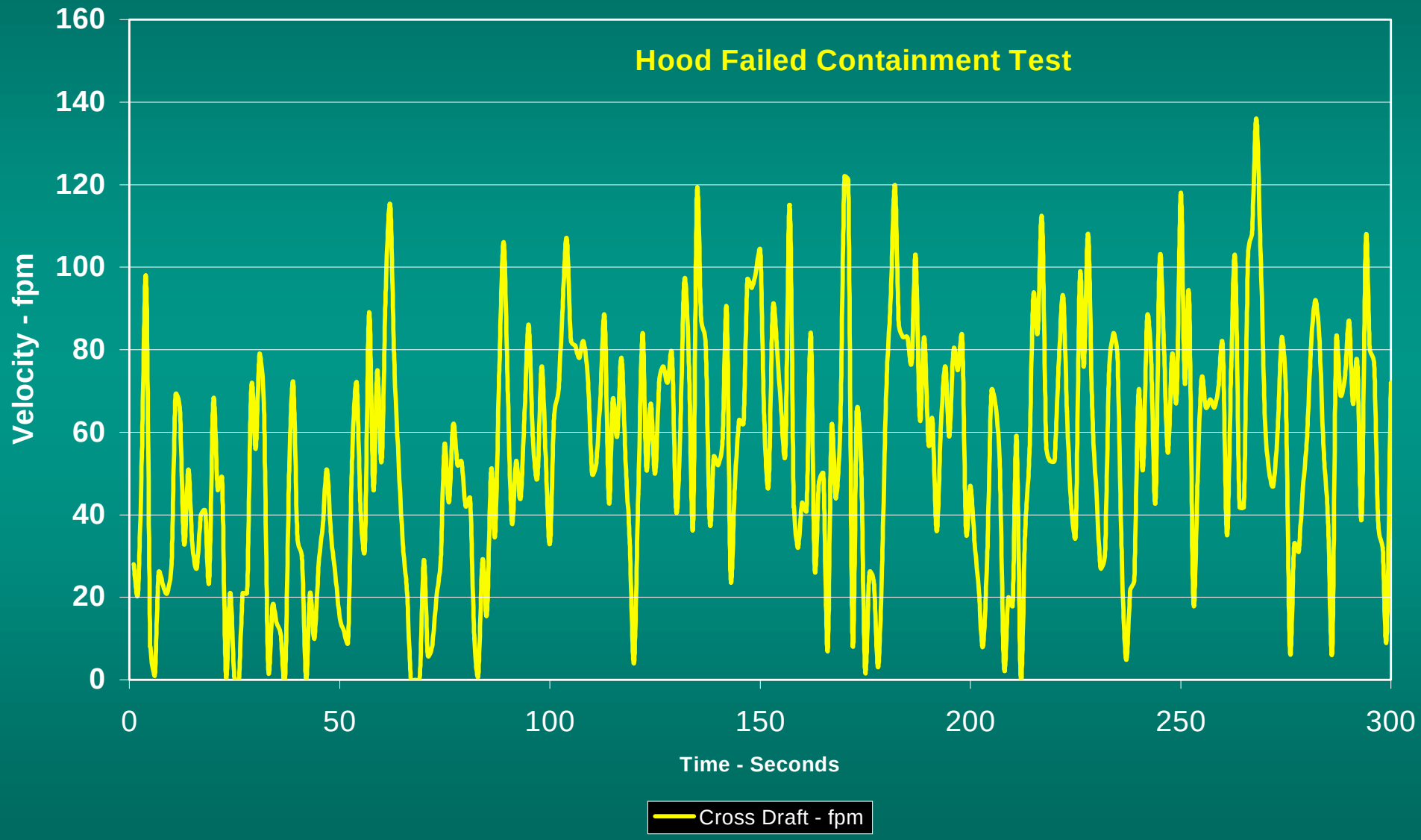
Front View

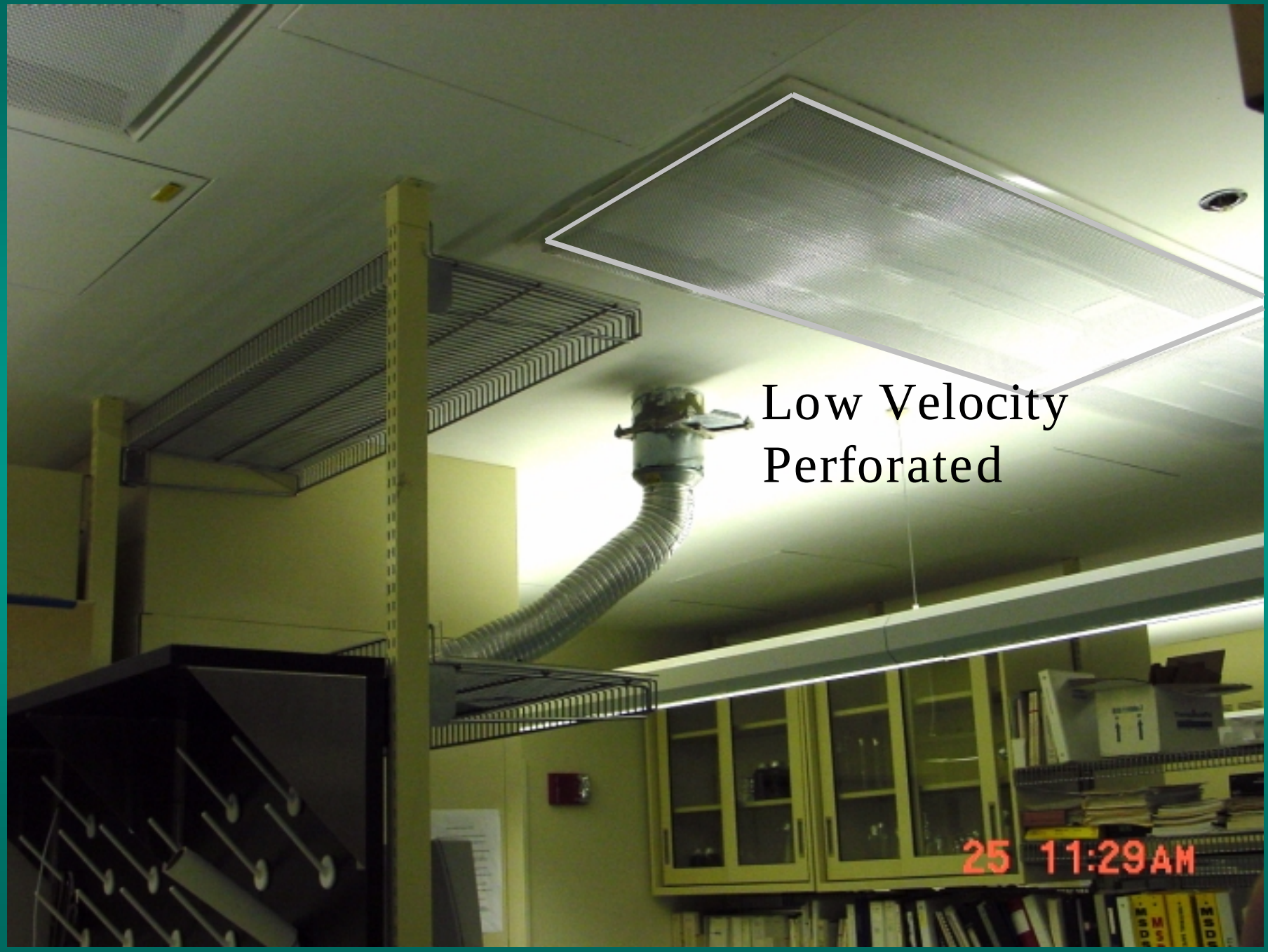


Side View

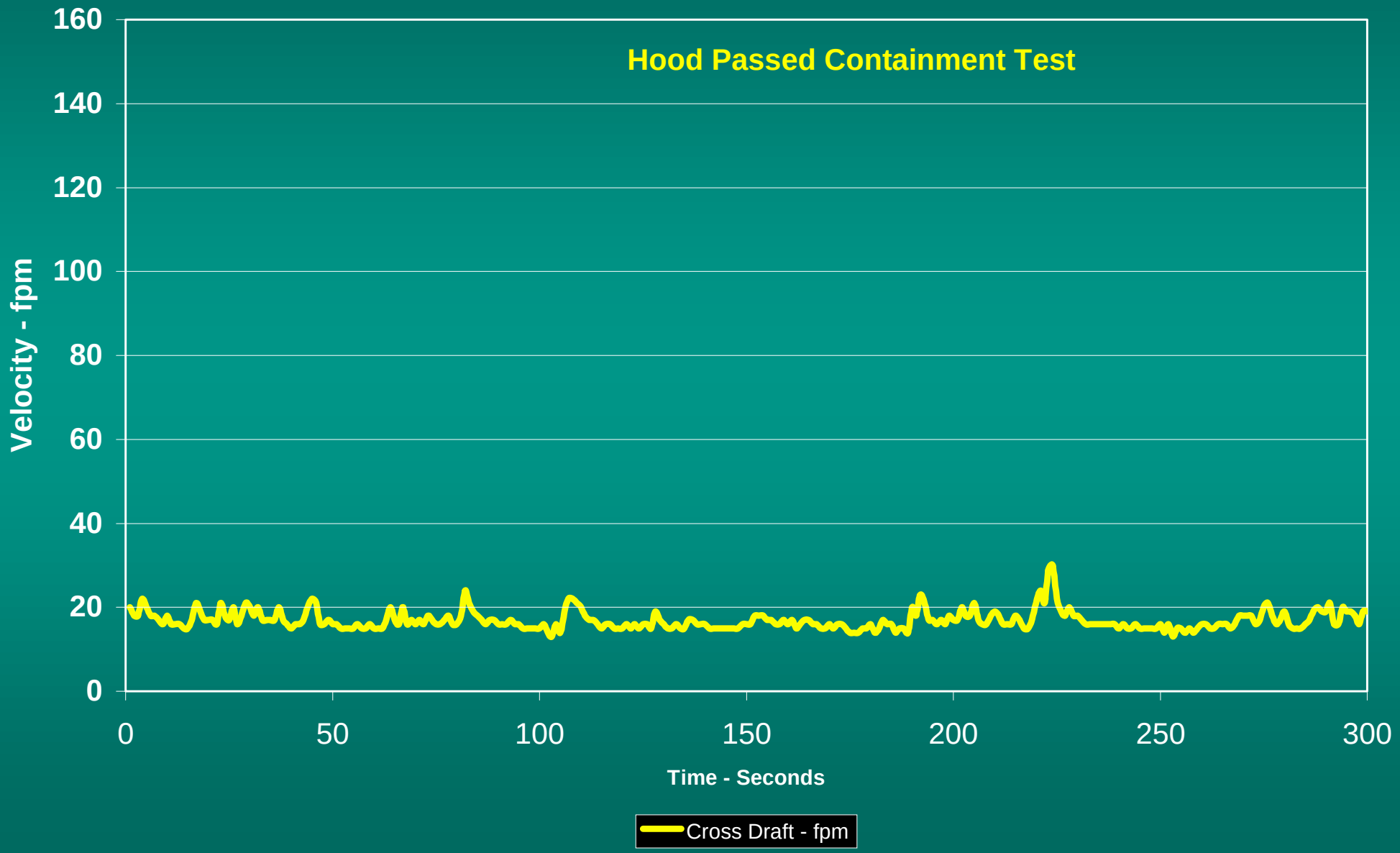

High Velocity Slot
25 11:44AM

Cross Drafts Near Hood Opening with Original High Velocity Diffuser




Low Velocity
Perforated
25 11:29AM

Cross Drafts Near Hood Opening with New Low Velocity Diffuser



High Velocity / High Aspiration Diffuser

*Not Suitable For Lab Use

Lab Temperature Control

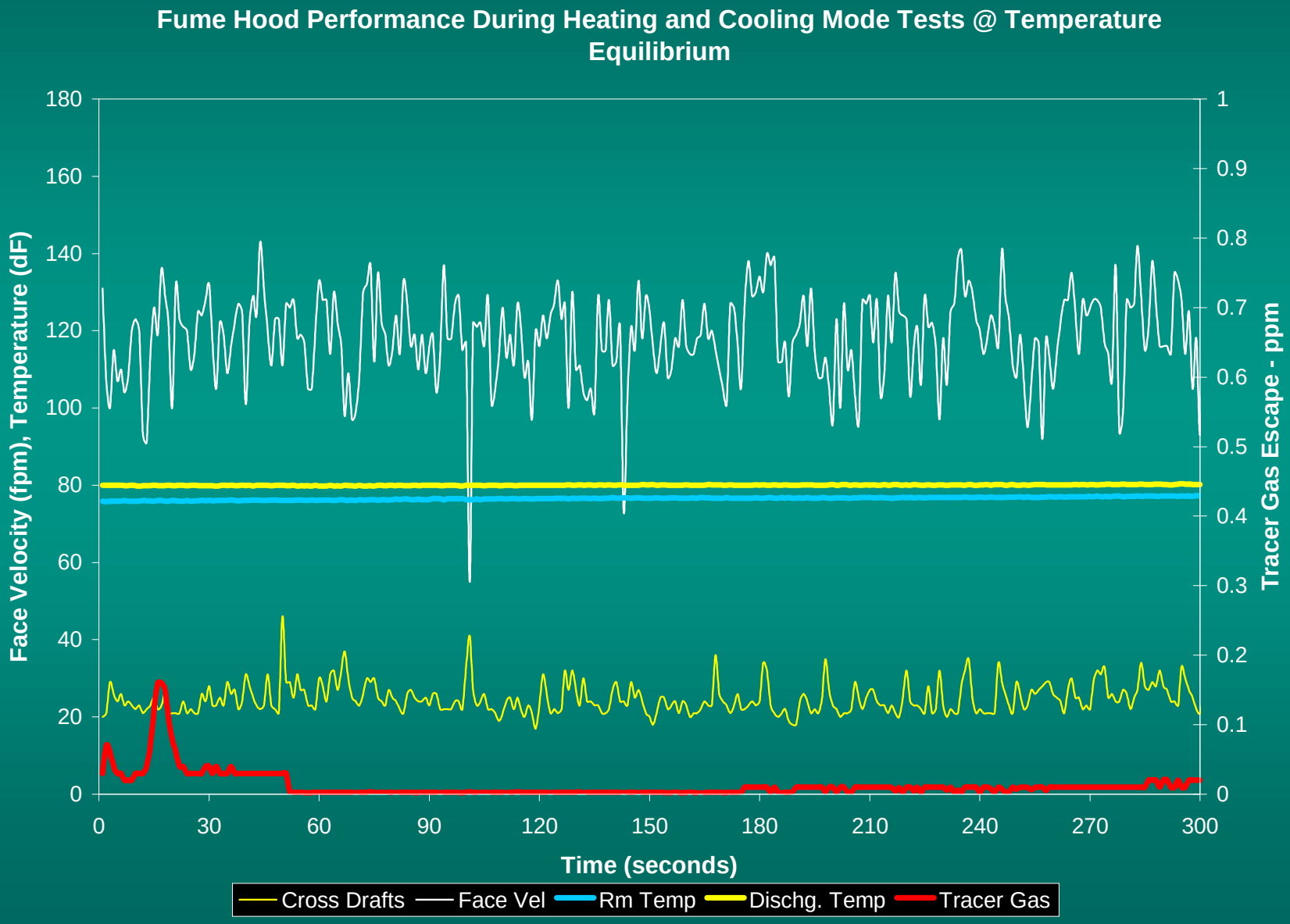
Diffuser Discharge Temperature

vs.

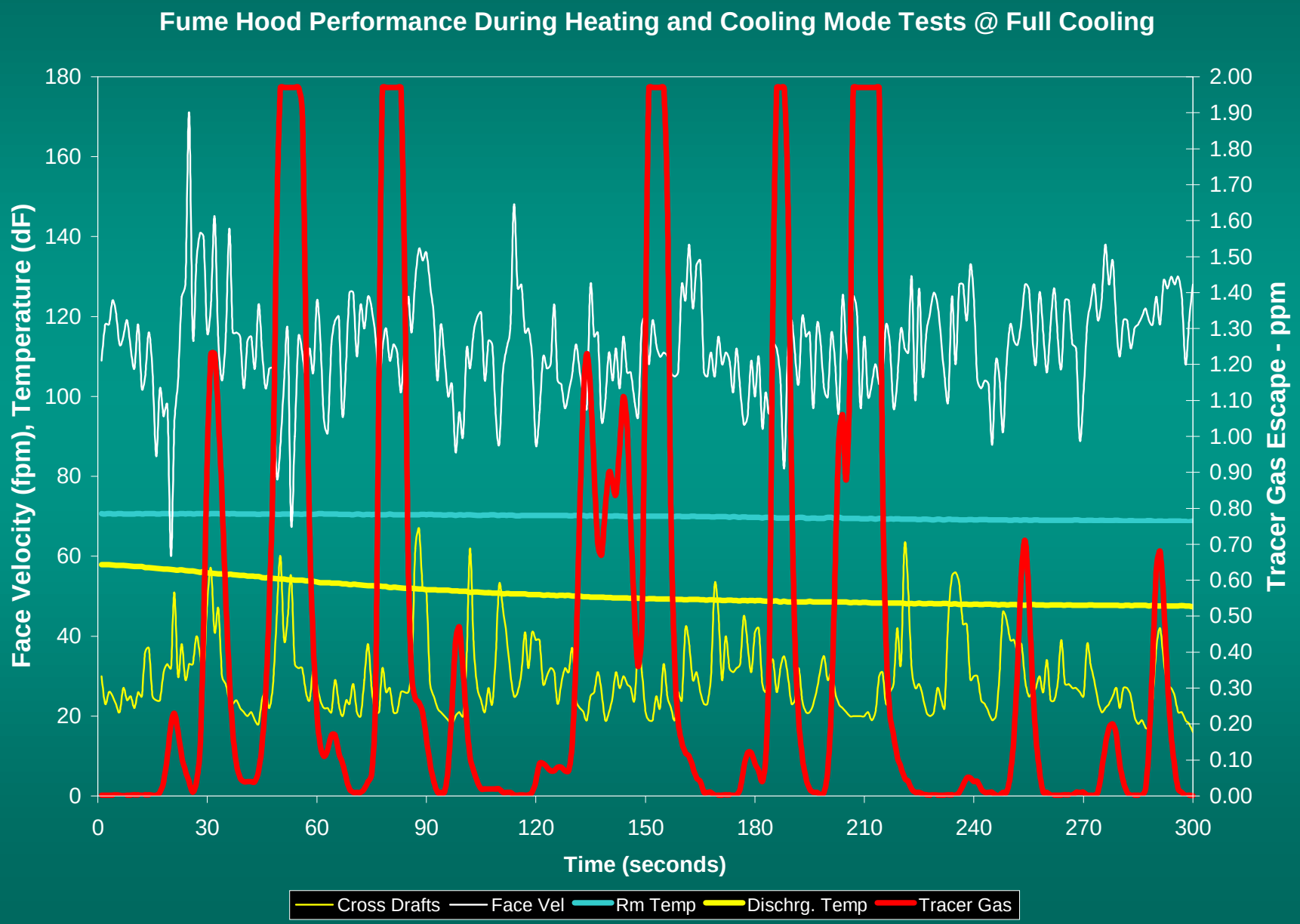
Space Temperature

- **Reheat Control**
- **Thermostat Location**
- **Room Air Patterns**

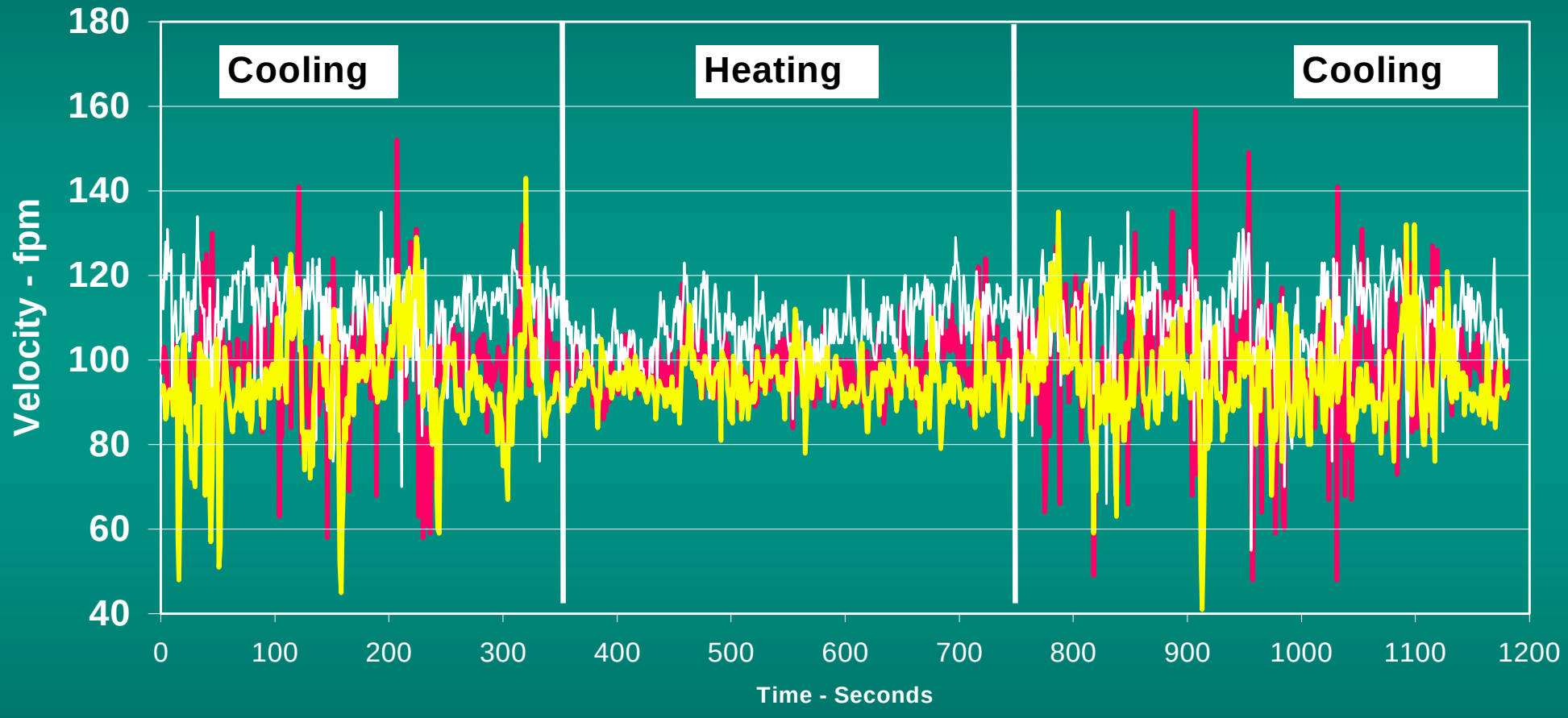
Effect of Temperature Stratification



Effect of Temperature Stratification



Plot of Face Velocities while adjusting Heating and Cooling Modes



Problem Resolution

- Adjust Hoods and Airfoil Sills
- Relocate VAV Boxes
- Tune Controls and Calibrate Sensors
- Relocate or Replace Problematic Diffusers
- Re-Balance Air Flows
- Relocate Thermostats and Control Discharge Temperatures

Optimizing System Effectiveness

- Develop Clear Performance Specifications
- Pre-Qualify Components - Mock-up if Necessary
- Customize Calibration and Commissioning Tasks
- Benchmark Operation
- [illegible]
  - Test and Maintenance Plan
  - Periodic Operation and Energy Audits
  - Renovation Procedures / Management of Change Plan
- Train Personnel